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Stopesia alveolata, a Fossil Seed of Trimeniaceae from the Lower Cretaceous (Albian) of Hokkaido, Northern Japan

TOSHIHIRO YAMADA[1*] and MASAHIRO KATO[2]

*[1]Division of Life Sciences, Graduate School of Natural Science and Technology, Kanazawa University, Kanazawa 920-1192, Japan. *ptilo@mb.infoweb.ne.jp (author for correspondence);*
[2]Department of Botany, National Museum of Nature and Science, Tsukuba 305-0005, Japan

Stopesia alveolata gen. et sp. nov., a fossil seed of Trimeniaceae from the Lower Cretaceous Yezo Group of Hokkaido, northern Japan, is described. *Stopesia alveolata* differs from extant seeds of *Trimenia* in its well-developed endosperm and absence of antiraphal vascular bundle, while it shares such seed coat characters as the multilayered stony exotesta with an alveolate surface, a parenchymatous mesotesta, and the operculate inner integument.

Keywords: Fossil seed, Hokkaido, Lower Cretaceous, *Stopesia alveolata*, Trimeniaceae

Extant Trimeniaceae are a small family distributed along an island chain stretching from Sulawesi to eastern Australia and the southwestern Pacific (Kubitzki *et al.* 1993, Wagner & Lorence 1999). The family comprises the sole genus *Trimenia*, including eight species (Kubitzki *et al.* 1993, Wagner & Lorence 1999). Until now, there were no unequivocal paleobotanical records for the family (Friis *et al.* 2006).

Recently, an unequivocal fossil seed of Trimeniaceae was reported from the Lower Cretaceous (late Albian) Hikagenosawa Formation of Mikasa, Hokkaido, Japan (Yamada *et al.* 2008). Yamada *et al.* (2008) argued that the current austral distribution of the family is relictual, and that the seed would not be assignable to the extant *Trimenia* because of the mode of nutrient storage and absence of antiraphal vascular bundles. Here, we describe the fossil seed as *Stopesia alveolata* gen. & sp. nov.

Material and Methods

The slides examined by Yamada *et al.* (2008) were reexamined by light microscopy. For reconstruction, the outline of the seed surface was traced, and surface views were compiled manually by overlaying successive camera lucida drawings.

Taxonomy

Stopesia alveolata T. Yamada & M. Kato, **gen. et sp. nov.** (Fig. 1)

Seed ellipsoid, 3 mm long, 2.2 mm thick, anatropous, bitegmic. Endosperm well developed, occupying larger area than perisperm. Embryo minute, encased in the micropylar region of endosperm. Micropyle endo- and exostomic. Antiraphal vascular bundles absent. Inner integument operculate in endostomic region, but mostly crushed in other

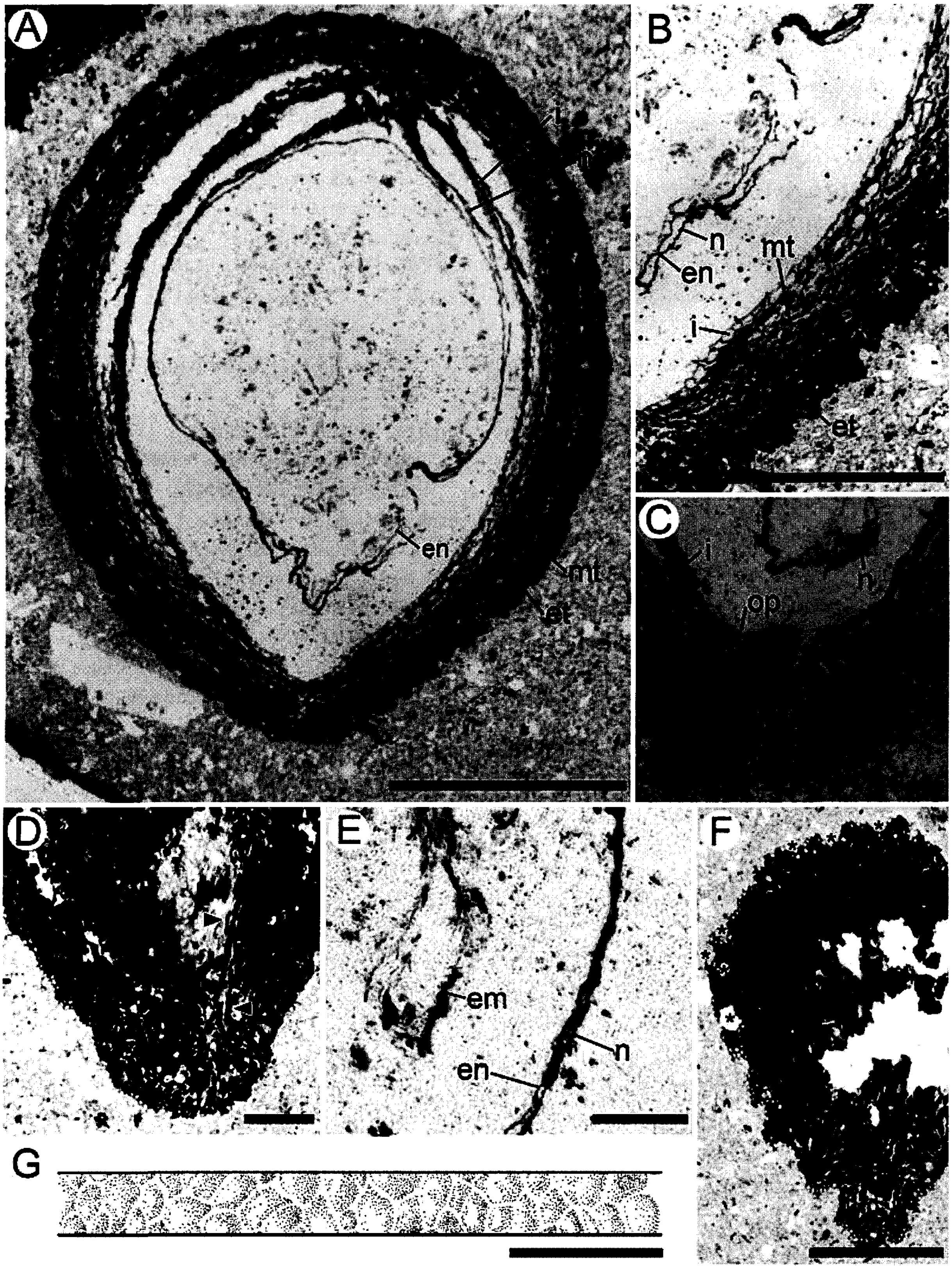

FIG. 1. *Stopesia alveolata* T. Yamada & M. Kato. A: Longitudinal section in plane tangential to raphe. B: Closeup of A, showing details of seed coat. C: Closeup of micropylar region. D: Raphal vascular bundle near hilum (arrowheads). E: Longitudinal section through embryo. F: Nearly paradermal section of exotesta. Areoles are indicated by asterisks. G. Reconstructed image of seed surface. Scale bars = 1 mm (A), 500 μm (B, F, G), 100 μm (C–E).

areas. Testa consisting of exotesta and mesotesta. Exotesta lignified, consisting of 1–5 layers of isodiametric cells, surface alveolate. Mesotesta parenchymatous, consisting of 4 or 5 layers of cells elongated longitudinally to seed axis.

Holotype. *NSM PP-9176* (Deposited in the Paleobotanical collection, the National Museum of Nature and Science, Tokyo).

Type strata. Albian Hikagenosawa Formation, Yezo Group, Pombetsu area, Mikasa City, Hokkaido, Japan.

Etymology. The generic name honors the Late Dr. Marie Stopes, who first studied the permineralized plant fossils of Japan. The epithet is from the alveolate surface of the seed.

Notes. Trimeniaceae are uniform in ovule and seed structures (Endress & Sampson 1983, Prakash 1998, Yamada *et al.* 2003). The extant trimeniaceous seeds are characterized by a testa consisting of a lignified multilayered exotesta with an alveolate surface and a nonlignified multilayered mesotesta (Endress & Sampson 1983, Prakash 1998, Yamada *et al.* 2003, Yamada *et al.* 2008). Although many families produce stony, thick seed coats, none but Trimeniaceae is known to produce a lignified exotesta with multiple cell layers (Yamada *et al.* 2008).

Stopesia alveolata shares the following characters with extant seeds of *Trimenia*; ellipsoid shape, relatively small size (3 × 2.2 mm), anatropy, bitegmy, bistomic micropyle, crushed inner integument with an operculum, lignified multilayered exotesta composed of isodiametric cells, alveolate surface of the exotesta, and nonlignified multilayered mesotesta (Yamada *et al.* 2008). These remarkable similarities unequivocally indicate the close affinity of *S. alveolata* to *Trimenia*. Seeds of *Stopesia alveolata* differ from those of *Trimenia* in the absence of antiraphal vascular bundle and well developed endosperm.

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